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CABBAGE DISEASES AND INSECTS.

By J. B. S. Norton and T. B. Symons.

The importance of the cabbage industry to Maryland, and the fact that at least 10 per cent of the whole, and often on some farms 25 or even 50 per cent of the yield, is lost through the depredations of insects and the attacks of fungous diseases, make desirable a consideration of the means of saving at least a part of this great loss.

CABBAGE DISEASES,

By J. B. S. Norton, State Pathologist.

GENERAL HEALTH CONSIDERATIONS.

Cabbage can withstand a great deal of abuse and do well if supplied with proper food and water; wet soil and hot dry air, however, are both detrimental. In the plant bed the principal dangers are want of light and crowding, and too hot and moist air; though they will stand a great deal of the latter. When the plants are grown in dark, close places, or crowded too much, they may be attacked by various "damping-off" fungi which kill the lower part of the stem. Proper conditions will prevent this, and more light and air and stirring the soil about the plants will check it. All roots, leaves and other waste from plants affected with club root, black rot, soft rot or wilt, if collected and burned will much reduce the chances of infection the following year. In transplanting the roots should be preserved as nearly entire as possible and not doubled back in planting; the cabbage is especially dependent on a good supply of water which must come through the root, so the plants need an abundance of roots since they cannot stand a wet soil.

In successful cabbage culture it is especially important to eradicate all weeds belonging to the cabbage or mustard family, and to not grow in rotation with radishes, horse radish, kale, etc., which are subject to the same diseases. Long rotations are important to prevent disease.

MILDEWS, ETC.

Downy mildew is recognized by spots of injured tissue on the leaves, on which the fruiting organs of the fungus, *Peronospora parasitica*, are seen as a delicate, white, downy appearance. It is rarely troublesome, except on young plants, and is increased by moist air. Injury can be much reduced by forcing the plants with nitrate of soda, spraying with Bordeaux mixture and reducing the water supply until the plants outgrow it. Strong Bordeaux mixture should not be used as it is slightly injurious to cabbage. Four pounds of copper sulphate and four pounds of lime to fifty gallons of water is a good formula.

Powdery Mildew, caused by *Oidium Balsamii*, and White Rust, *Albugo candida*, occasionally cause similar injury, but the spore-bearing areas appear as less downy, white patches on the leaves.

A black mould fungus, *Macrosporium Brassicæ*, is also seen frequently on cabbage in this State, causing black spots on the outside leaves, but does not do serious injury to cabbage that is well cared for.

CLUB ROOT.

This disease, causing the roots to become distorted and knotty, and the plants to develop imperfectly or die, is caused by a minute organism, *Plasmodiophora Brassicæ*, which lives in great numbers in the diseased root. It is most troublesome in low, wet lands. It was introduced from Europe, and is not generally distributed in Maryland, but is very bad in some localities. Care should be exercised not to distribute it over the field when the presence of occasional distorted roots indicate that it is getting a foothold on the place, as the germ is said to remain active in the soil for 20 years. The same disease is found on turnips, and weeds like mustard, shepherd's purse, peppergrass, cress, etc., and these propagate it when cabbage is not present. Good drainage and cultivation are the most helpful treatments. From 75 to 100 bushels, according to the character of the soil, of air slacked lime applied to the land the autumn before planting, has been very helpful. Abandonment of the infected land for cabbage culture for as much as seven years is often necessary.

BLACK ROT.

Black rot has not been prominent until recent years, but is now causing serious injury on many farms in this State and elsewhere. The disease is caused by a kind of bacteria, *Pseudomonas campestris*, the germs of which enter the plant through the water pores on the edge of the leaves where the drops of exuded water may be seen after a cool, damp night, or through insect injuries on the leaves or broken roots in the soil. The disease is best recognized by the yellowing leaves with brown or black veins which are injured by the bacteria and in which they occur in countless numbers. The heads may become dwarfed or be entirely wanting. The disease also occurs on turnip, kale, cauliflower and similar plants, and on wild mustard and other cruciferous plants. Probably some varieties are more subject to the disease, but this has not been definitely determined. Conditions most favorable for cabbage growth favor the disease.

TREATMENT: Make the seed bed far away from where other cabbage has been grown and take precautions to keep the soil from being infected through manure. Burn over the bed before sowing the seed and do not set plants that show signs of the disease on the young leaves. Do not plant on infected ground, or even, if possible, where cabbage has been grown until after some years, if the disease is in the neighborhood. The diseased plants should be kept from manure, and for this reason should not be eaten by animals. Keep down the cabbage-eating insects which carry the disease. Market the crop early to prevent further decay in storage. It is very important to keep the germs out of the soil, for if once infected, it is almost impossible to get the land free again.

WILT.

A disease caused by a species of Fusarium, a soil fungus, acting somewhat like black rot, and also causing the leaves to wilt and drop off one by one leaving a bare stem and a tuft of leaves on top, is bad in many places in Maryland. When it is found the land must be abandoned for cabbage growing and every precaution taken to keep it from spreading.

SOFT ROT.

Soft rot, caused by one or more species of bacteria, often attacks growing cabbage, causing a soft, brownish decomposition of the lower or central part of the head, especially on thrifty, succulent plants. The same occurs in storage piles. No field treatment can be recommended

To prevent rotting when cabbage is kept in piles or trenches for winter use, the heads should be pulled in dry weather, and before covering all water should be drained from the leaves, and if soft rot, or black rot was present in the field, all heads showing signs of rot at the base of the head or on the leaves should be discarded or stored by themselves. The important point in storage is to protect the heads from water, but keep them moist and as near freezing temperature as one can without reaching it.

SOME INSECTS AFFECTING CABBAGE,

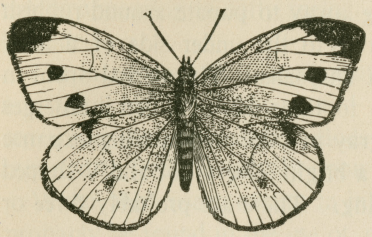
T. B. Symons, Associate State Entomologist.

THE IMPORTED CABBAGE BUTTERFLY (Pieris Rapæ).

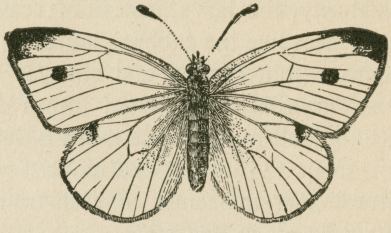
All cabbage growers are familiar with this little yellowish white butterfly with black spots that darts here and there over the cabbage patch. It is the adult of the dreaded cabbage worm, which, without doubt, is the worst cabbage pest that market growers have to contend with. The butterfly appears as early as the first of March in this locality, and at once commences laying eggs on the cabbage, turnips, radishes or mustard. The larva hatches from the egg in about ten days. After feeding for about ten days it crawls to any dry rubbish or fence and changes to the pupa. It remains in the pupa state about twelve days, when the adult butterfly emerges. There are many generations during the season, until finally, in the late fall, the insect either winters over in the adult or pupa state.

When the worms are present on the cabbage, without doubt Paris green and London purple are the most reliable remedies to be used. Some growers are afraid to spray their cabbage plants with an arsenite when they are half grown, or larger; but there is not the slightest danger of injuring anyone by such procedure. For if the cabbages were sprayed the day before cutting, and then treated in the usual way by the cook, one devoted to the vegetable could not devour a sufficient quantity to cause him the slightest apprehension from the poison. Spraying the plants with an arsenite about one-third of a pound to 50 gallons of water will be effective in controlling the pest. Slacking about a pound of lime and adding to the arsenical solution will help in causing the solution to remain longer on the leaves. Applying the arsenite in powder form, that is, by adding one part of the poison to fifteen or twenty parts of flour or

plaster and dusting on the plants, preferably in the morning, will give the desired results. If, however, one should not like to use Paris green where the plants are heading, applications of Hellebore will be effective and the poison will disappear more rapidly. Kerosene emulsion can also be applied with some success.



The Imported Cabbage Butterfly, male (After Riley).

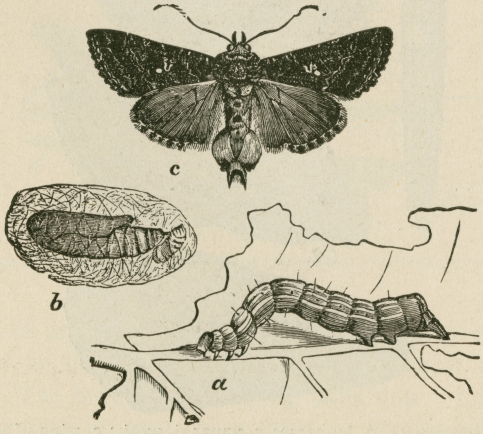


The Imported Cabbage Butterfly, female (After Riley).

As a preventive against the attacks of this insect, planting turnips, radishes or some other plant of the mustard family that flowers early in the season, on the border of the cabbage field, will attract the butterfly, and possibly the pest could there be given more thorough treatment.

THE CABBAGE PLUSIA (Plusia brassicæ).

This insect does considerable injury to cabbage, especially later in the season, and in fact its injury is often times considered to have been



The Cabbage Plusia; a, caterpillar; b, chrysalis in cocoon; c, moth, male (After Riley).

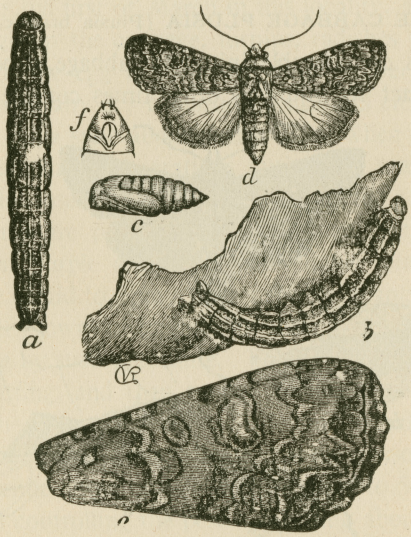
done by the common cabbage butterfly. The moths, which are nocturnal insects, appear in the spring and lay their eggs similarly to the

cabbage butterfly. The larva, in which stage the insect does its damage, is dark green, but distinctly marked with white longitudinal lines. They are not provided with prolegs in the sixth and seventh seguments, like most nocturnal insects; so, in traveling over the surface of a leaf, they loop the body like the "measuring worm." Upon reaching maturity, the larva, instead of crawling away to pupate around rubbish or fences like the cabbage butterfly, crawls to the under side of a leaf, spins a thin cocoon and changes to a chrysalis. The period spent in the chrysalis ranges from fifteen days to three weeks, when it emerges as an adult moth. The moth is dark gray in color with a wing expanse of about 1 ½ inches, and marked with a bright silvery dot and V-shaped mark near the centre of each front wing. There are probably three or four broods in this State.

The remedies suggested for the cabbage butterfly can be employed with effectiveness against this pest.

THE CABBAGE MAMESTRA (Mamestra trifolii).

The larva of this moth is often seen in connection with the cabbage plusia and the imported cabbage butterfly. Its larva can easily be dis-



The Cabbage Mamestra; a, b, larvæ; c, pupa; d, moth; e, wing of same, enlarged. (After Riley).

tinguished from others by a pinkish stripe down each side. The caterpillar is quite variable in color, some being bright green above and some

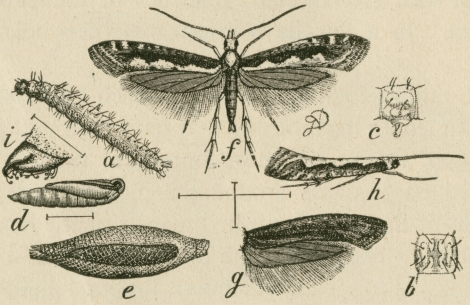
nearly brown; but all have the characteristic stripe on each side. The parent moth is somewhat variable in both size and color, ranging from a pale yellowish-gray to a dark brownish-gray. It is readily distinguished from the moth of the Plusia by the lack of silvery spots in the upper side of the fore wings. The insect winters in the pupa state, the moths appearing in early spring. There are at least two broods in this latitude.

The insect does its injury by eating the leaves and boring into the heads and stems of the cabbage, and has the habit usually to feed at night, remaining under stones and clods of earth during the day. They are also reported to feed extensively upon the common pursley.

When this insect occurs in injurious numbers, the best remedies will probably be found in the use of poisoned baits, and in the application of arsenites on the plants.

THE CABBAGE PLUTELLA (Plutella cruciferarum).

This little active pale-green worm, about an inch in length, does much damage at times by eating the outer leaves of the cabbage and other *Cruciferæ*. The larva pupates within a beautiful, delicate, gauze-like cocoon, through which the enclosed pupa can plainly be seen. The



The Cabbage Plutella; a, larva; d, pupa; e, cocoon; f, moth; greatly enlarged. (After Riley).

adult insect is of an ash gray color, with narrow wings expanding about five-eighths of an inch. There are probably three or more broods in this latitude. The insect winters in the pupa state. Likewise with this pest the application of arsenites or kerosene emulsion will be effective. The preventive of clean culture and destroying all rubbish along fence rows will curtail the presence of many of the so-called cabbage worms.

THE CABBAGE ROOT MAGGOT (Phorbia brassicæ).

While this pest is commonly known as the cabbage root maggot, it by no means restricts its ravages to this plant, but usually confines itself to the *Cruciferæ* or mustard family.

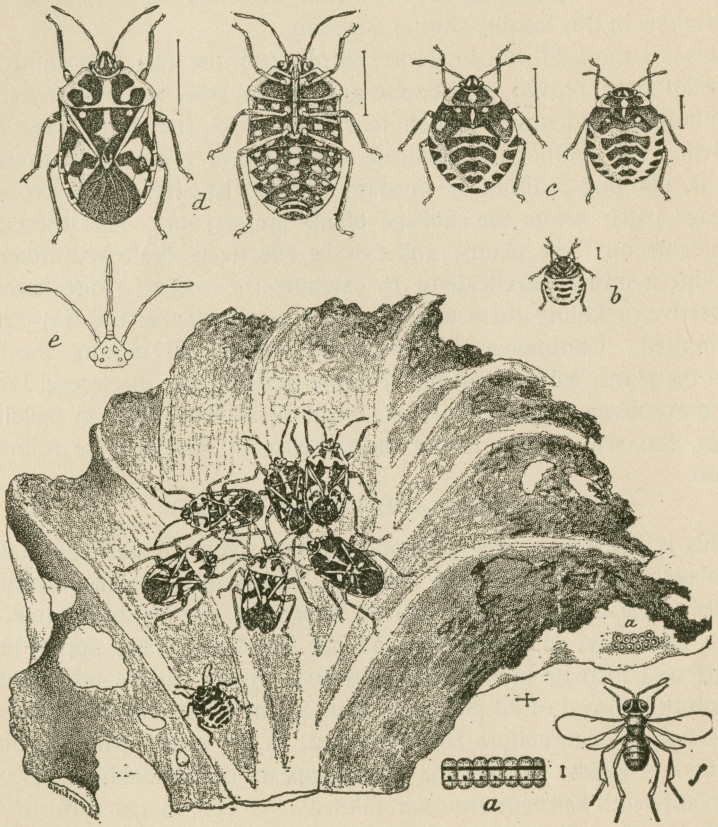
According to Prof. Slingerland, Bulletin 78, Entomological Division, Cornell University, the adult fly appears in the early spring and lays her eggs on the soil near the stem of the young cabbage plants, usually after they are transplanted to the field, although injury has been reported by this insect to plants in the beds. In a few days the eggs hatch and the young maggots attack the surface of the roots. They then work their way to the tender rootlets; when these are destroyed the maggot works on the main root, into which it burrows. Upon reaching maturity, it is about a half inch long, shining white and cylindrical in form. It crawls an inch or two into the soil away from the roots, and there enters the pupa state. The fly emerges about three weeks later and crawls to the surface. The female then commences to lay eggs for the second generation. Prof. Slingerland reports a second brood; the flies of this second brood appearing about June 15 and the maggots working in July. It is probable that the insect winters in the pupa and adult stages. The presence of this insect on cabbage and allied species of plants is detected by a checking of their growth and a tendency of the leaves to wilt badly under a hot sun. In a few days afterwards the whole plant wilts and dies.

In bulletin 27, Entomological Division, Cornell University, Prof. Slingerland discusses at length the remedies that have been put forth by different experimenters, and among the more important may be mentioned the placing of tarred paper cards around the plants before setting out into the field, to prevent the adult from laying eggs or the larva from getting at the desired point. The application of carbolic acid to the plants after they are set, using the following formula: 1 pound hard soap dissolved in 1 gallon boiling water, into which 1 pint crude carbolic acid is poured and the whole mass agitated into an emulsion, and taking 1 part of this standard emulsion and diluting it with 30 equal parts of water; treating shortly after the plants are set out and repeating once each week or ten days until about May 15 will be sufficient. It is necessary to remove some of the earth from about the plants before treating. Applying the ordinary kerosene emulsion, diluted to 15 per cent, would give equally good results.

Carbon bi-sulphide has also been used with success. This liquid is injected into the soil a short distance from the plants, the former passing through the soil and killing the insects at work on the plant without injuring it. Care must be exercised not to allow too much of the liquid to pass through the soil and hurt the plants. If the cabbages are grown extensively, this remedy may prove to be expensive. More detailed information upon the treatment of this pest will be given upon application.

THE HARLEQUIN CABBAGE BUG (Margantia histrionica).

There is no doubt that this insect is the more troublesome to many of our gardeners. It invariably appears each year in our cabbage patches in enor-



The Harlequin Cabbage Bug; a, eggs enlarged; b, young enlarged; c, young more enlarged; d, adults seen from above and below, enlarged: e, outline of head of adult, enlarged; f, parasite enlarged. Other figures natural size. (After Johnson.)

mous numbers. The adult presents a bright mottled red, yellow and black appearance, which renders it conspicuous. The insect is nearly half an inch long and about half as broad. It winters in the adult state, under rubbish or in such crevices as it may find large enough to crawl into. In spring, when the warm weather sets in, it appears and feeds on whatever cruciferous plants it may find. They are particularly fond of mustard plants, and will often live on these until midsummer. The eggs are laid on the under side of the leaves, and hatch in from four to ten days, according to the temperature. The young larva at once begins its work, thrusting its beak into the plant tissue and extracting its juices, thus causing the plant to wilt and eventually die. The young reach maturity in from 16 to 30 days. According to Dr. Smith, there are from three to four generations in this locality during a season.

This is a most difficult insect to control from the fact that diluted insecticides have proved of little use against the pest, and when solutions have been applied strong enough to kill the bugs, the plants have been injured. The planting of trap crops seem to have given the best results, that is, planting radishes or mustard around the edges of the proposed cabbage patch before the cabbage plants are set out. The insects will congregate on these plants, and can be effectively destroyed either by applying a strong insecticide or by catching the insects. Pure kerosene is effective in killing them when it is not cared whether the trap plants are injured. Commencing early in the season and picking the bugs from the plants will prevent much future trouble from the second brood. The preventive of clean culture and cleanliness about the farm buildings, fences, etc., will greatly reduce the presence of this pest the following season.

CABBAGE APHIS (Aphis brassicæ).

This is likewise a very common cabbage pest. A cabbage plant is often seen covered with these little lice, which suck the juices from the plants. The insects may winter in either the egg or adult state; the latter, especially, in pits where cabbage is stored. They appear in the spring and increase in enormous numbers. Injury can be prevented by a prompt removal of all plant remnants left in a field after the heads are taken out. Clean culture is emphasized, as the insects will live on all cruciferous weeds. When the insect appears on the cabbage, spraying the plants with kerosene emulsion diluted to 10 or 15 per cent, or with a tobacco decoction will be effective in controlling them.